ALTRO THRESHOLD OPTIMIZATION

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Tracking Focus Group Meeting - 23 September, 2015

Overview

- The goal of this study is to use the TPC data recording bandwidths more efficiently;

- TPC data readout goes through the ALTRO chip that has readout threshold value which could be customized;

- This study was performed to understand the effects of the threshold change and optimize its value as a function of primary track reconstruction efficiency.
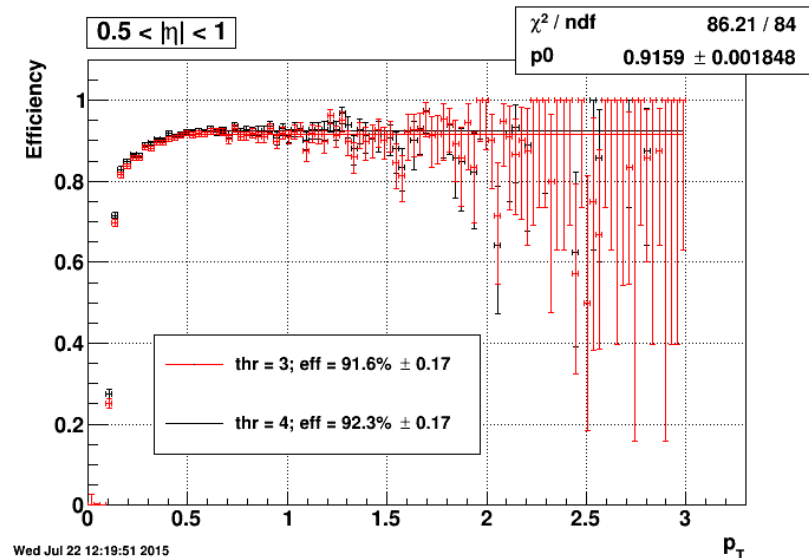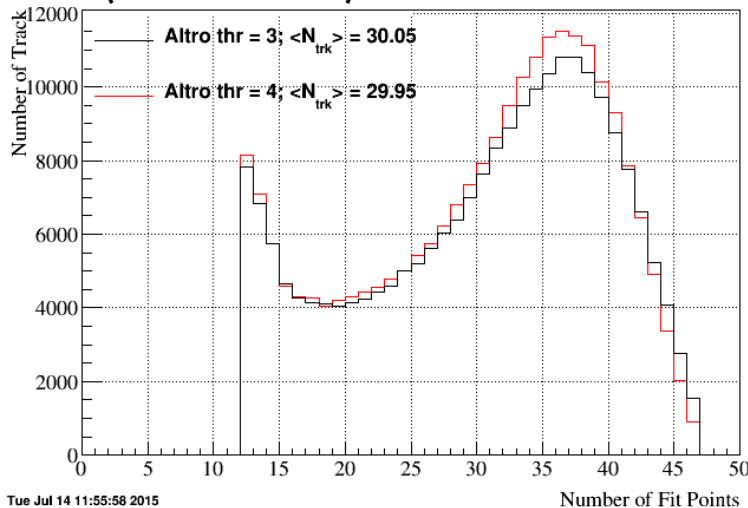
Simulation

- HIJING simulation of Au-Au collisions at 200 GeV energy was used for the study (with 2014 STAR geometry);

- The efficiency on the plots is for the primary tracks with at least 15 hits on track used for $\frac{dE}{dx}$ fit;

- For studies in data and in embedding 2014 Au-Au zerobias daq files were used.
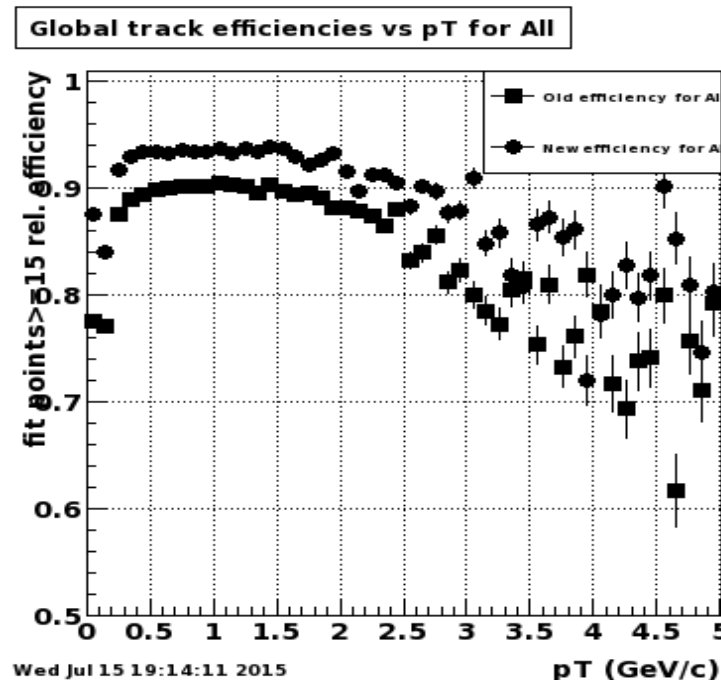
Threshold change 3→4 (Simulation)

- In current setup the threshold value is 3;

- Tanko's suggestion was to set it to 4;

- This change reduces total number of hits, as expected, but average number of hits per track stays the same due effective increase of length of the reconstructed tracks;

- This translates into a slight increase in the efficiency of the track reconstruction (about 0.5%).

Altro thr = 3; $<N_{trk}>$ = 30.05
Altro thr = 4; $<N_{trk}>$ = 29.95

Number of Track

Number of Fit Points

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$0.5 < |\eta| < 1$

χ^2 / ndf   86.21 / 84
p0   0.9159 ± 0.001848

Efficiency

thr = 3; eff = 91.6% ± 0.17
thr = 4; eff = 92.3% ± 0.17

p_T

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Threshold change 3→4 (Data)

- Efficiency study performed on data yielded larger increase in reconstruction efficiency;

- Difference is likely due to underlying event activity in the high luminosity Au-Au data which is not present in the simulation.

Threshold change 3→4 (Embedding)

- To illustrate the effects of the "underlying event hypothesis" the same study was performed on the exactly same MC events embedded in the exact same data;

- The difference in reconstruction efficiency is about 2 times larger in the embedded sample.
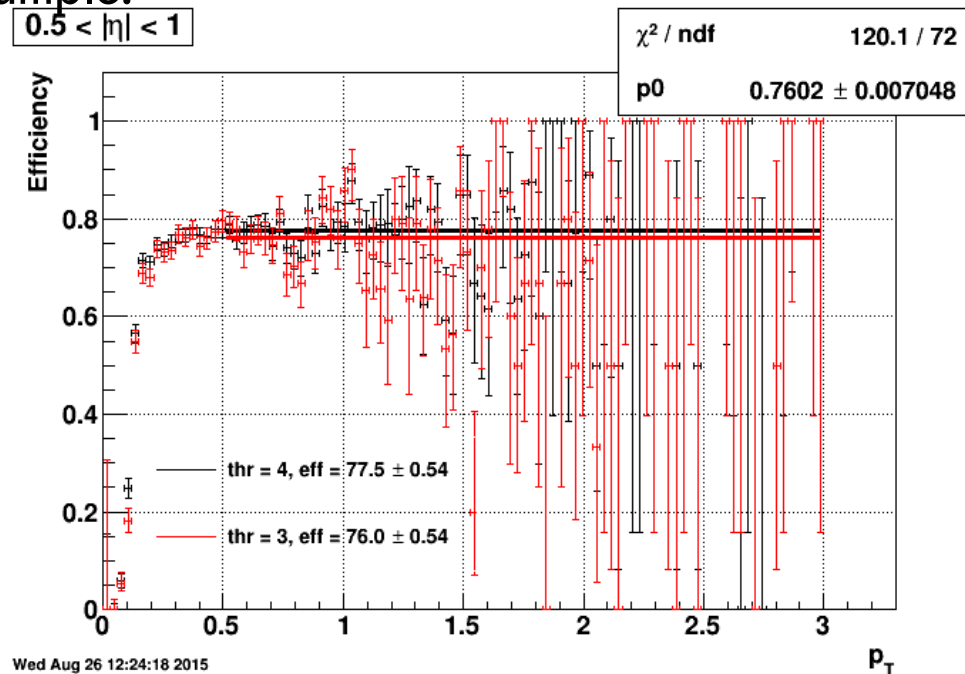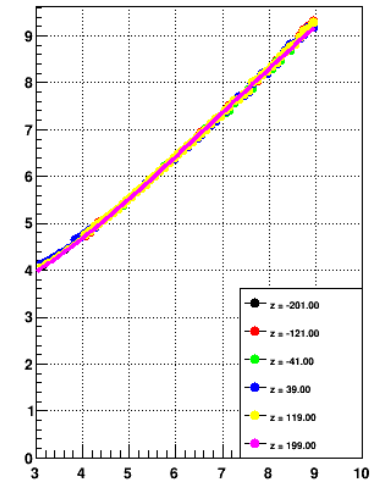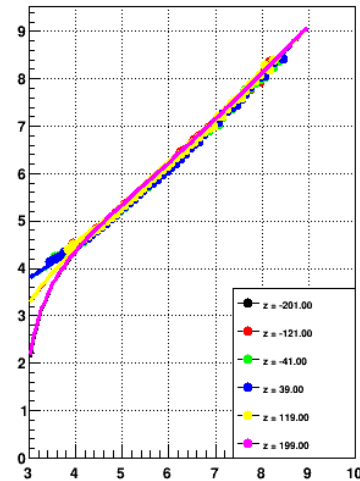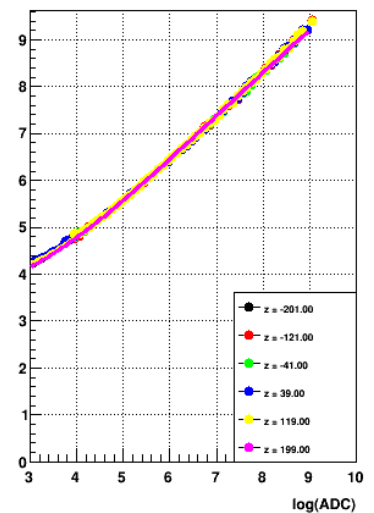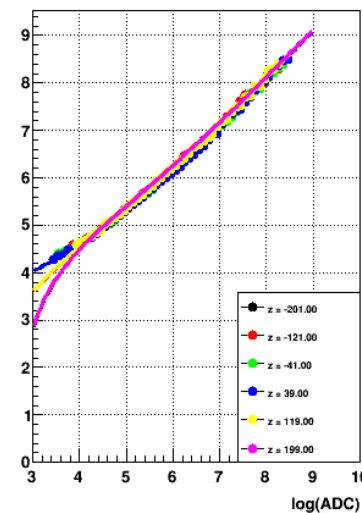
Effects on dE/dx resolution

- The correction factors for $\frac{dE}{dx}$ calculation were recalculated for the threshold 4 value;

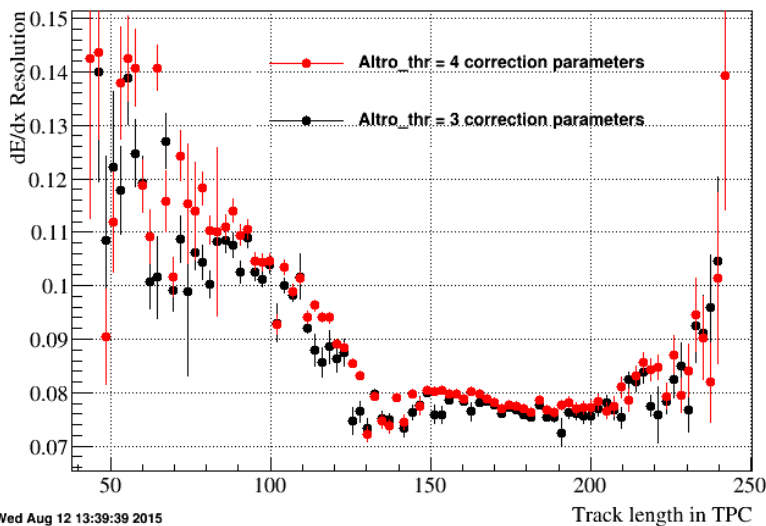- The resolution of $\frac{dE}{dx}$ measurement is not affected by the change;

log(simulated ADC) versus log(recon. ADC) and Z

log(simulated ADC) versus log(recon. ADC) and Z

Altro_th = 4 dE/dx resolution for different correction parameters

- Altro_thr = 4 correction parameters
- Altro_thr = 3 correction parameters

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Track length in TPC

Threshold Optimization

- Other values of the ALTRO threshold were also considered for its optimization;

- Expected behavior of the reconstruction efficiency as a function of threshold was observed;

- Optimization shows that threshold 4 is the optimal case.
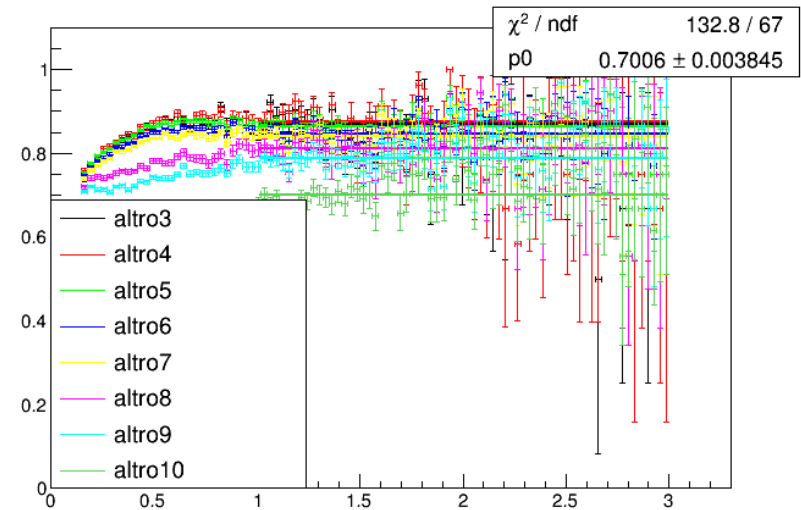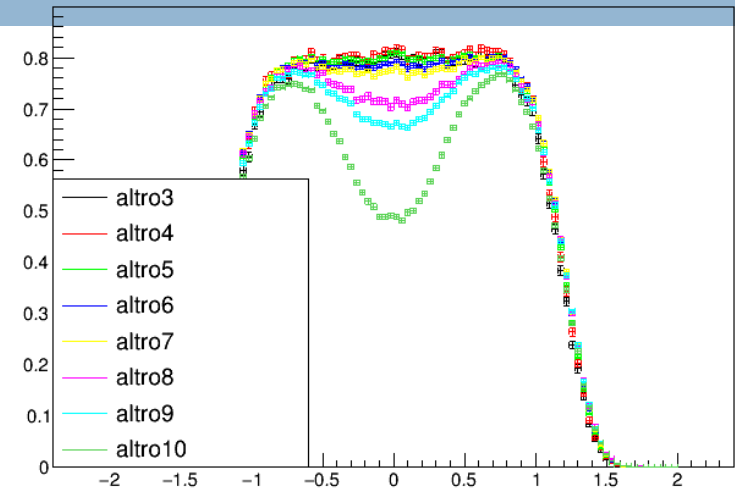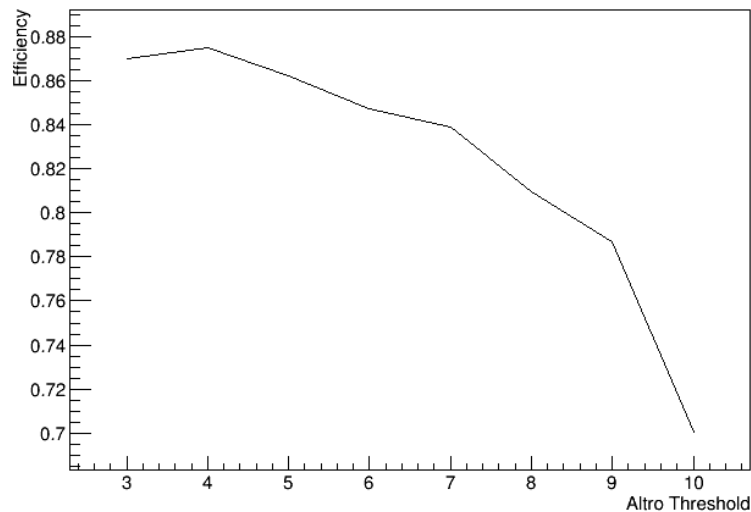
Summary

- Threshold increase reduces the number of hits in TPC, as expected, but average number of hits per track remains the same;

- It was shown that ALTRO threshold change from 3 to 4 does not worsen the track reconstruction but even benefits it by removing "bad" hits;

- Above mentioned was demonstrated in pure MC as well as in data and in embedded sample;

- The optimization study showed that threshold value of 4 maximizes the primary track reconstruction efficiency;